

**73. BIOTECHNOLOGY****CHEMISTRY****Part-A (40 Marks)**

Coordination Compounds, Applications of Coordination Compounds, Organometallic Chemistry, Metal Carbonyls and Related Compounds, Boranes and Carboranes, Inorganic Reaction Mechanisms, Bioinorganic Chemistry, Hard and Soft Acids and Bases (HSAB). Carboxylic Acids and Derivatives, synthesis Based on Carbanions, Nitro Hydrocarbons, Amines, Cyanides and Isocyanides, Heterocyclic Compounds, Carbohydrates, Amino Acids and Proteins, Pericyclic Reactions, Synthetic Strategies, Asymmetric Synthesis. Electrochemistry and Emf, Chemical Kinetics, Thermodynamics. Photochemistry, Molecular Spectroscopy, Proton Magnetic Resonance Spectroscopy, Mass Spectroscopy.

S-Block Elements, P-Block Elements, Chemistry of Zero Group Elements, Chemistry of d-Block Elements, Chemistry of f-Block Elements, General Principles of Inorganic Qualitative Analysis, Symmetry of molecules, Non-Aqueous Solvents, Chemical Bonding, Molecular Orbital Theory, Theory of Quantitative Analysis, Theories of Bonding in Metals. Structural Theory in Organic Chemistry, Acyclic Hydrocarbons, alicyclic Hydrocarbons, aromatic Hydrocarbons, Arenes and Polynuclear Aromatic Hydrocarbons, Halogen Compounds, Alcohols, Phenols, Ethers and Epoxides, Carbonyl Compounds, Conformational Analysis, Stereochemistry of Carbon Compounds. Atomic Structure and Elementary Quantum Mechanics, Gaseous State, Liquid State, Solutions, Dilute Solutions and Colligative Properties, Solid State Chemistry, Phase Rule, Colloids and Surface Chemistry, adsorption, Material Science, Nano materials, Evaluation of Analytical Data.

**BIOTECHNOLOGY****Part-B (60 Marks)****CELL BIOLOGY AND GENETICS**

Cell as basic unit of living organisms-bacterial, fungal, plant and animal cells, Structure of chromosome- morphology, components of chromosomes (histones and nonhistones), specialized chromosomes (Polytene, Lampbrush), Chromosomal aberrations - structural and numerical, Eukaryotic cell cycle -phases, Mitosis - Stages (spindle assembly)-significance, Meiosis- Stages (synaptonemal complex) - significance, Apoptosis. Mendel's experiments- factors contributing to success of Mendel's experiments, Law of segregation- Monohybrid Ratio; Law of independent assortment- Dihybrid Ratio, Trihybrid Ratio, X-Y chromosomes - Sex determination in Drosophila, Birds, Man, Bonellia; X-linked inheritance- Hemophilia and Color blindness; X-inactivation; Y-linked inheritance - Holandric genes, Linkage and recombination- Cytological proof of crossing over, phases of linkage, recombination frequency, gene mapping and map distance

**NUCLEIC ACIDS AND BIOINFORMATICS**

DNA as the genetic material- Griffith's experiments on transformation in Streptococcus pneumonia, Hershey-Chase experiments, Avery, MacLeod and McCarty's experiments, RNA as genetic material- Tobacco Mosaic Virus, Structure and forms of DNA (A, B and Z), Genome organization in prokaryotes, Genome organization in eukaryotes, C-value and C-value paradox, Reassociation kinetics-cot curve, Denaturation, Renaturation, Tm curve, Kinetic classes of DNA- unique sequences, moderately repeated and highly repeated sequences; tandem repeats (satellite, minisatellite and micro satellites), interspersed repeats (SINES-eg: Alu repeats, LINES); palindromic sequences and transposable genetic elements.

DNA replication- enzymes; semi conservative DNA replication-Messelson and Stahl experiment; Linear, Circular, Rolling circle, Theta, D loop models, Mutation- spontaneous, induced (frame shift, transition, transversion), Physical and chemical mutagens, DNA damage- intrinsic and extrinsic factors, DNA repair- Direct, Excision and methyl mediated mismatch, recombinational and SOS repair, DNA recombination- homologous, site specific recombination and NHEJ (Non-Homologous End Joining). Bioinformatics-Storage of databases in DNA (GenBank, EMBL, DDBJ), Protein data banks (PDB, SWISS-PROT, UNIPROT, PIR) and their utilization, Data retrieval tools-BLAST, ENTREZ

**BIOCHEMISTRY AND BIOSTATISTICS**

Biomolecules -Carbohydrates- importance, classification; structure and functions of monosaccharides (glucose & fructose), disaccharides (sucrose, lactose & maltose) and polysaccharides (starch, glycogen & insulin), Amino acids- importance, classification, structure, physical and chemical properties of amino acids; peptide bond formation, Proteins- importance, structure of proteins-primary, secondary, tertiary and quaternary, Lipids- importance, classification- simple lipids (triacylglycerides & waxes), complex lipids (phospholipids & glycolipids), derived lipids (steroids, terpenes & carotenoids) ,Fatty acids- importance, classification- saturated (palmitic acid, arachidic acid) and unsaturated fatty acids (oleic acid & linoleic acid), Enzymes- importance, classification and nomenclature; Michaelis-Menton Equation, factors influencing the enzyme reactions; enzyme

inhibition (competitive, uncompetitive & mixed), Co-enzymes. Probability, probability distribution- Binomial, Poisson and Normal distributions, Test of significance- Null hypothesis and Alternate hypothesis, Chi-square test- degrees of freedom and their applications to biology (goodness of fit), Analysis of variance (One-way ANOVA) and their applications to biology.

#### **BIOENERGETICS AND BIOANALYTICAL TECHNIQUES**

Glycolysis, tricarboxylic acid (TCA) cycle, electron transport, oxidative phosphorylation, Gluconeogenesis and its significance, Transamination and oxidative deamination reactions of amino acids and  $\beta$ -oxidation of fatty acids. Colorimetry: Beer and Lambert's laws and UV- vis spectrophotometry, Principle and applications of chromatography (paper, thin layer & HPLC), Electrophoresis (Agarose & SDS-PAGE), Principle and applications of centrifugation (preparative & analytical)

#### **MICROBIOLOGY AND IMMUNOLOGY**

Historical development of microbiology and contributors of microbiology, Outlines of classification of microorganisms, Structure and general characteristics of bacteria and virus, Disease causing pathogens and symptoms (Eg: Mycobacterium, Hepatitis). Methods of sterilization- physical and chemical methods, Bacteriological media: LB media, EMB agar; Identification of bacteria by staining methods, Bacterial growth curve and factors affecting bacterial growth, Fungal media- PDA, Sabourauds agar. Types of immunity- innate and adaptive immunity, Cells of the immune system: T-cells (helper and cytotoxic cells), B-cells, Natural killer cells, Macrophages, Basophils and Dendritic cells, Primary organs of immune system- Thymus and Bone marrow, Secondary organs of immune system- Spleen and Lymph nodes. Antigens-immunogenicity vs antigenicity, factors affecting antigenicity, epitopes, Haptens & types of adjuvants, Humoral and Cell mediated immunity, Structure of immunoglobulin; types and functions of immunoglobulins (IgG, IgA, IgM, IgE & IgD)

#### **MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY**

Structure of prokaryotic gene (promoter, initiator & terminator regions), Structure and functions of RNA polymerase. Transcription mechanism- initiation, elongation & proof reading, termination, Genetic code- properties, deciphering of genetic code, wobble hypothesis, aminoacylation, Translation mechanism- initiation and termination, Operon concept, Lac operon. Gene expression and regulation in eukaryotes- Structure of eukaryotic gene (promoter, exons, introns, terminator, enhancer & silencer), Transcriptional machinery in eukaryotes (RNA polymerases), structures and transcriptional factors (basic, upstream & regulatory), Transcription- initiation (formation of transcriptome), elongation and termination, Post-transcriptional modifications- capping, polyadenylation, Splicing (self & protein mediated) and alternative splicing, Translation- initiation, elongation and termination. Enzymes useful in molecular cloning: Restriction endonuclease, DNA ligases, polynucleotide kinase, klenow enzyme, DNA Polymerase- I, reverse transcriptase, alkaline phosphatase, terminal nucleotidyl transferase, Cloning Vectors: PBR 322, Bacteriophage, Cosmid, Phagemid, Shuttle vectors, Gene transfer techniques: Physical, Chemical and Biological methods, Polymerase Chain Reaction and its applications

#### **MICROBIAL TECHNOLOGY**

Industrial biotechnology- scope and applications, Exploitation of microorganisms and their products, Principles of Fermentation technology, Types of fermentation, Microbial production of Organic acids (Lactic acid, citric acid), Amino acids (Glutamic acid, Aspartic acid, Lysine), Fermentation by microbes for food additives: dairy products (Cheese, Yogurt), beverages (Beer, Wine) and antibiotics (Streptomycin, Erythromycin), Therapeutic drugs: Recombinant vaccines, monoclonal antibodies, insulin, vitamins, Biofuel: Hydrogen, Alcohol, Methane.